NASA-CR-196402

FINAL REPORT

Analysis for ^{7}Be and ^{10}Be on LDEF Materials
and Their Sources

Contract No. NAS8-38609
D.O. 27

Submitted to NASA MSFC
July, 1994

by:

J. C. Gregory
Dr. John C. Gregory
Principal Investigator
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

(NASA-CR-196402) ANALYSIS FOR Be-7 AND Be-10 ON LDEF MATERIALS AND THEIR SOURCES Final Report (Alabama Univ.) 6 p

N95-70111

Unclas

Z9/25 0019662

^{10}Be IN TERRESTRIAL BAUXITE AND INDUSTRIAL ALUMINUM: AN LDEF FALLOUT

J.C. Gregory
The University of Alabama in Huntsville
Department of Chemistry
Huntsville, AL 35899-2900
Phone: 205/895-6028, Fax: 205/895-6061

A. Albrecht and G. Herzog
Rutgers Univerity
Department of Chemistry
New Brunswick, NJ 08901
Phone: 908/932-3955, Fax: 908/932-5312

J. Klein and R. Middleton
University of Pennyslvania
Physics Department
Philadelphia, PA 19104-6396
Phone: 215/898-8832, Fax: 215/898-2010

B.A. Harmon and T.A. Parnell
NASA, Marshall Space Flight Center
Space Science Laboratory, ES62
Huntsville, AL 35812
Phone: 205/544-4924, Fax: 205/544-7754

SUMMARY

Work has continued on the search for ^{10}Be on metals other than aluminum flown on LDEF. Much time-consuming extractive chemistry has been perfomed at Rutgers University on turnings obtained from the ends of two stainless steel trunnions from LDEF and the prepared samples will be run on the University of Pennsylvania accelerator mass spectrometer.

We have continued to investigate our discovery of naturally-occurring ^{10}Be contamination in bauxite and industrial aluminums from different sources. Measurements of ^{10}Be in ores from three different sites, and from four different samples of commercial aluminum have been made.

Paper presented at the Third LDEF Post-Retrieval Symposium, Williamsburg, VA, Nov. 8-12, 1993

INTRODUCTION

The discovery of ^{7}Be on front surfaces of LDEF pointed the way towards an investigation of the possibility of finding other radionuclides produced in the atmosphere. At the present time these appear practically limited to ^{10}Be and ^{14}C, though ^{26}Al must certainly be present in very small quantities (from Ar spallation).

^{10}Be quantification is particularly attractive since its surface and atmospheric chemistry will be virtually identical to that of ^{7}Be. The production and sink functions of both nuclides are well known, therefore if both surface densities were known on the same piece of satellite material, we should obtain a probe of the vertical transport mechanism of the isotopes in the atmosphere. If the process is diffusion-controlled, the different isotope masses should provide clear indication.

The first attempt to obtain this information was foiled by the discovery that much, if not all, commercial aluminum, including that used to make LDEF and A0114 is naturally contaminated with ^{10}Be. This is not surprising since many bauxite ores are found close to, or on the ground surface, and may be wetted by rainfall which has scrubbed the Be isotopes out of the air.

In this work we describe some measurements of a sampling of several metal samples from different sources (e.g., kitchen foil, shop aluminum and LDEF metal) and of some bauxite ores from different locations. This gave some idea of the variance, but was not a systematic survey.

Table 1 shows the raw data obtained by AMS. The metals showed levels of 40 to 110 x 10^6 (±10%) atoms of ^{10}Be per g Al.

Table 1. ^{10}Be concentrations of aluminous materials.

Sample	Source	Mass [mg]	MassAl[1] [mg]	^{10}Be/^{9}Be [10^{-15}]	^{10}Be [10^6 atom/g Al]	Normal Be [10^{-9} g/g Al]
Al AA Sol'n		140.0	140.0	63±4	61±3	159
Al foil		327.3	327.3	102±7	41±3	58
Al plate	LDEF[2]	256.7	256.7	122±8	75±3	
	LDEF 9-7[3]	219.7	219.7	101±6	63±5	
	Shop	315.2	315.2	223±22	111±11	140
Bauxite	NBS 69A	1371.8	381.3	74±10	22±2	
Bauxite, Ark.	A 21485[4]	361	141.5	48±4	15±2	
Bauxite, Haiti		497.7	52.2	33000±200	57200±3800	
Blank[5]				6±2		
Blank[6]		2085		5±1		

Notes: 1) Aluminum concentrations in the bauxites from Arkansas and Haiti were determined by DCP analysis to be 39.2% and 10.5%, respectively; **NIST** bauxite NBS 69A was used as a standard (27.8% Al). 2) Not flown; 3) Flown. 4) Label given by the American Museum of Natural History (New York, NY, USA); 5) Reagent blank; 6) Procedural blank run with stainless steel.

Flown. 4) Label given by the American Museum of Natural History (New York, NY, USA); 5) Reagent blank; 6) Procedural blank run with stainless steel.

Bauxites, on the other hand, showed values from 20 to 57,000 x 10^6 atoms ^{10}Be per g of Al in the ores. Aluminum and beryllium oxides are chemically quite similar and typical bauxites contain normal ^9Be at levels of about 10 ppm. During aluminum refining this is reduced by a factor of about 70 times.

Thus, if we take our measured value for typical metal of 5-10 x 10^7 atoms ^{10}Be /gAl, this would require a level of 5×10^9 atoms ^{10}Be/g Al in the ore. This compares with measured values in ores of 2×10^7 atoms per g Al in the Arkansas ore and 6 x 10^{10} atoms per g Al in the Haitian ore (equivalent to 6 x 10^9 atoms per g of Haitian ore).

Table 2 shows ^{10}Be densities per gram of soil or ore. The theoretical maximum was estimated from an average U.S. rainfall and assumes the only sink function to be radioactive decay. On this scale the concentration of ^{10}Be in the Haitian ore seems remarkable, but not impossible.

Table 2. ^{10}Be atom densities per gram soil or ore

Theoretical max (1m)	1 x 10^{10} atoms g^{-1}
US Typ. soil (surface)	2 x 10^8 - 1 x 10^9
NBS and Ark ore	1 x 10^7
Haitian ore	6 x 10^9

Implications for AMS:

Analysts may wish to determine both ^{26} Al and ^{10}Be in a rock, in which case they may add both Be and Al carriers, but 5 mg of modern Al may contain 5 x 10^5 (^{10}Be atoms), providing a significant unwanted ^{10}Be background (for comparison, 5g quartz from Bandelier Tuff contains 5 x 10^6 atoms of ^{10}Be).

- need to use selected carriers
- Al cathodes should not be used for AMS sputtering

CONCLUSIONS

- Modern commercial Al contains
  ^{10}Be at the level of 5-10 x 10^7 atoms/g
  and ^{9}Be at the 50-100 ppb level.

- Bauxite contains ~ 10 ppm 'normal' ^{9}Be. About 1% of the Be (both isotopes) makes it through the refining process to Al metal.

- ^{10}Be was almost certainly produced from atmospheric sources rather than *in situ*.

- ^{10}Be concentrations in bauxites reveal their exposure histories to rainfall.

- It might be interesting to study the distribution of ^{10}Be in an ore body.

- AMS analysts will now take more care with Al carriers used in ^{26}Al and ^{10}Be assays.

Report Documentation Page

NASA National Aeronautics and Space Administration

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle FINAL TECHNICAL PROGRESS REPORT FNAS LDEF Radiation Sig		5. Report Date March 1, 1994
		6. Performing Organization Code
7. Author(s) John C. Gregory		8. Performing Organization Report No.
		10. Work Unit No.
9. Performing Organization Name and Address The University of Alabama in Huntsville Huntsville, AL 35899		11. Contract or Grant No. NAS8-38609, D.O. 27
		13. Type of Report and Period Covered FINAL
12. Sponsoring Agency Name and Address George C. Marshall Space Flight Center National Aeronautics and Space Administration MSFC, AL 35812		14. Sponsoring Agency Code
15. Supplementary Notes		
16. Abstract		
17. Key Words (Suggested by Author(s))		18. Distribution Statement UNCLASSIFIED-UNLIMITED
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of pages / 22. Price